

I B. Tech I Semester Supplementary Examinations Sept. - 2014
MATHEMATICS-II (MATHEMATICAL METHODS)

(Common to ECE, EEE, EIE, Bio-Tech, EComE and Agri.E)

Time: 3 hours

Max. Marks: 70

Question Paper Consists of **Part-A** and **Part-B**
 Answering the question in **Part-A** is Compulsory,
 Three Questions should be answered from **Part-B**

PART-A

1. (i) Write iterative scheme to find the cube root of a real number $K(>0)$.
- (ii) Express shift operator E in terms of exponential function.
- (iii) Given $y' = x + y$, $y(0) = 1$, find the value of $y(0.4)$ (take $h = 0.2$) using Euler's method.
- (iv) Find Fourier series of $f(x) = |x|$ in $(-2, 2)$.
- (v) If F_p is complex Fourier transform of $f(x)$, then find the complex Fourier transform of $f(x) \cos ax$.

(vi) Prove that
$$Z(\sinh nt) = \frac{z \sinh t}{z^2 - 2z \cosh t + 1}.$$

[3+3+3+3+5+5]

PART-B

- 2.(a) Find positive root of $x^3 - 5x + 3 = 0$ using bisection method up to 4 steps.
- (b) The population of a town in the decadal census is given below. Estimate the population of a town for the year 1895

Year X	1891	1901	1911	1921	1931
Population Y	46	66	81	93	101

[8+8]

- 3.(a) Using Newton-Raphson method Compute $\sqrt{41}$ correct to 4 decimal places.
- (b) Using Lagrange's interpolation formulae find the value of $y(12)$ from the data

X	4	7	8	10
Y	10	15	17	21

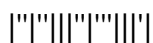
[8+8]

- 4.(a) Solve $y' = xy + 1$, $y(0)=1$ using Taylors method up to 3rd degree term and compute $y(0.1)$.

- (b) Find the fourier series of $f(x) = x^2 - x$ in $(-\pi, \pi)$. Hence deduce that

$$\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \dots = \frac{\pi^2}{6}.$$

[8+8]



5.(a) Find half range sine series of $f(x) = \begin{cases} 1, & 0 < x < \frac{\pi}{2} \\ -1, & \frac{\pi}{2} < x < \pi \end{cases}$.

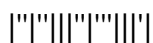
(b) Use Runge-Kutta 4th to compute $y(1.25)$ given that $\frac{dy}{dx} = \frac{x+y}{x}$, $y(1) = 2$ [8+8]

6.(a) Find Fourier transform $f(x) = \begin{cases} x & \text{if } |x| \leq a \\ 0 & \text{if } |x| > a \end{cases}$.

(b) Find Z-transform of $n^2 a^n$. [8+8]

7.(a) Find Fourier cosine transform of e^{-ax} , $a > 0$ and hence deduce the inversion formula.

(b) If $Z[f(n)] = \frac{z}{z-1} + \frac{z}{z^2+1}$, find $Z[f(n+2)]$. [8+8]



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PART-A

- 1.(i) Using a numerical method for the square root of 11.
- (ii) P.T. $\delta = E^{1/2} - E^{-1/2}$.
- (iii) If $y' - x + y$, $y(0.4) = 1.48$, find $y(0.9)$ with $h = 0.25$ using Euler's method and compare it with exact solution.
- (iv) Find the Half range Fourier sine series of $f(x) = |x|$ in $(0, 1)$.

(v) Prove $F[x^n f(x)] = (-i)^n \frac{d^n}{dp^n} [F(p)]$.

(vi) Prove that $Z(\cosh nt) = \frac{z(z - \cosh t)}{z^2 - 2z \cosh t + 1}$.

[3+3+4+4+4+4]

PART-B

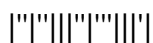
- 2.(a) Find the root of the $x^4 - x^3 - 2x^2 - 6x - 4 = 0$ lying between 2 and 3 upto 4 stages.
- (b) Use Gauss forward interpolation formulae to find $f(30)$ solve that
 $f(21) = 18.4$, $f(25) = 17.8$, $f(29) = 17.1$, $f(33) = 16.3$ and $f(37) = 15.5$. [8+8]

- 3.(a) Find a positive root of $2x = 3 + \cos x$ by using Newton-Raphson method.
- (b) Using Lagrange's Interpolation formula for the value of $y(1.3)$ given the following table

X	0.7	0.9	0.95	1.2
Y	1.25	1.5	2.0	2.7

[8+8]

- 4.(a) Solve $y' = y - x^2$, $y(0) = 1$ using Picard's method up to third approximation and hence find the value of $y(0.1)$.
- (b) Find the Fourier expansion of $f(x) = x \cos x$, $0 < x < 2\pi$. [8+8]



5.(a) Find half range cosine series of $f(x) = \begin{cases} 1, & 0 < x < \frac{\pi}{2} \\ -1, & \frac{\pi}{2} < x < \pi \end{cases}$.

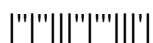
(b) Find $y(0.1)$ using 4th order Runge-Kutta method given that $y' = x + x^2y$, $y(0) = 1$. [8+8]

6.(a) Find the Fourier transform of $\frac{1}{\sqrt{|x|}}$.

(b) Find Z-transform of $n^2 e^{n\theta}$. [8+8]

7.(a) Find Fourier cosine transform of $\frac{1}{1+x^2}$ and hence find Fourier sine transform of $\frac{x}{1+x^2}$.

(b) Solve $y(n+2) + 3y(n+1) + 2y(n) = 0$, $y(0) = 0$, $y(1) = 1$ using Z-Transform. [8+8]



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PART-A

1.(i) Find reciprocal of a real number K using Newton-Raphson method.

(ii) Prove that $\mu = \frac{1}{2}[E^{1/2} + E^{-1/2}]$.

(iii) Employ Taylor's method to obtain the values of y(1.1) for the differential equation $y' = xy^{1/3}$, $y(1) = 1$. Compare the solution with exact solution.

(iv) A sinusoidal voltage $E \sin \omega t$ is passed through a half wave rectifier which clips the negative portion of the wave. Develop the resulting periodic function

$$u(t) = \begin{cases} 0 & , -\frac{T}{2} < t < 0 \\ E \sin \omega t, & 0 < t < \frac{T}{2} \end{cases}, T = \frac{2\pi}{\omega} \text{ as Fourier series.}$$

(v) Prove that $F\left[\frac{d^n}{dx^n} F(x)\right] = (-ip)^n F(p)$

(vi) Prove that $Z(\sin nt) = \frac{z \sin t}{z^2 - 2z \cos t + 1}$.

[3+3+4+4+4+4]

PART-B

2.(a) By using Regula-Falsi method for a real root of $xe^x = 2$ up to 4 stages.

(b) Using a Backward difference formula, find y(8) from the given table

X	0	5	10	15	20	25
Y	7	11	14	18	24	32

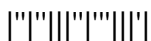
[8+8]

3.(a) Using Newton-Raphson formula, find the root between 0 and 1 of $x^3 = 6x - 4$ correct to 3 decimal places.

(b) Using Lagrange's Interpolation formula, find the value y(2) given the following table of values

X	1	1.1	1.4	1.8
Y	2	4	8	11

[8+8]



4.(a) Using Euler's method, solve for y at x = 0.5 from $y' = 2xy$, $y(0) = 1$ using step size 0.25.

(b) Find the Fourier series of $f(x) = \begin{cases} 0 & , -\pi < x < 0 \\ \frac{\pi x}{4} & , 0 < x < \pi \end{cases}$ and hence deduce that

$$1 + \frac{1}{3^2} + \frac{1}{5^2} + \dots = \frac{\pi^2}{8}.$$

[8+8]

5.(a) Represent the function as Fourier sine series $f(x) = \begin{cases} \frac{\pi}{2} & , 0 < x < \frac{\pi}{2} \\ \pi - x & , \frac{\pi}{2} < x < \pi \end{cases}$

(b) Use Runge-Kutta 4th order to compute y(1.25) for the equation $y' = \frac{x+y}{x}$, $y(1) = 2$.

[8+8]

6.(a) Find the Fourier sine transform of $\frac{e^{-ax}}{x}$.

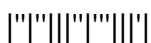
(b) If $Z[f(n)] = \frac{z}{z-1} + \frac{z}{z^2+1}$ find $Z[f(n+2)]$.

[8+8]

7.(a) Find Fourier transform of $f(x) = \begin{cases} x & \text{if } |x| \leq a \\ 0 & \text{if } |x| > a \end{cases}$.

(b) Solve $u_{n+2} - 6u_{n+1} + 9u_n = 0$ using Z-transform.

[8+8]



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PART-A

- 1.(i) Evaluate $\sqrt[3]{28}$ to four decimal places by Newton-Raphson method.
- (ii) If the interval of differencing is unity, $\Delta \tan^{-1}\left(\frac{n-1}{n}\right) = \tan^{-1} \frac{1}{2n^2}$.
- (iii) Using Taylor's series method obtain $y(0.2)$ for the differential equation $y' - 2y = 3e^x$, $y(0) = 0$. Compare with exact solution.
- (iv) Find the Fourier series of $f(x) = |\cos x|$ in $(-\pi, \pi)$.
- (v) Find Fourier transform of $f(x) = \begin{cases} 1, & |x| < a \\ 0, & |x| > a \end{cases}$ and hence evaluate $\int_0^\infty \frac{\sin p}{p} dp$.
- (vi) Prove that $Z(\cos nt) = \frac{z(z - \cos t)}{z^2 - 2z \cos t + 1}$.

[3+3+4+4+4+4]

PART-B

- 2.(a) Find a real root of $x^3 - 4x - 9 = 0$ using Regula-Falsi method up to 4 stages.
- (b) Using Gauss Backward difference polynomial, find $y(5)$ given that

X	0	3	6	9	12
Y	5	11	13	15	17

[8+8]

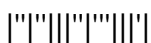
- 3.(a) Using Newton-Raphson method, find a positive root of $\cos x - x e^x = 0$.
- (b) Using Lagrange's Interpolation, find $f(x)$

X	4	7	8	10
Y	10	15	17	21

[8+8]

- 4.(a) Using Euler's method, solve for y at $x = 0.4$ from $y' = 2xy$, $y(0) = 1$ using step size 0.2
- (b) Find the Fourier series of periodicity 3 for $f(x) = 2x - x^2$ in $0 < x < 3$.

[8+8]



5.(a) Represent the function as Fourier cosine series $f(x) = \begin{cases} \frac{\pi}{2}, & 0 < x < \frac{\pi}{2} \\ \pi - x, & \frac{\pi}{2} < x < \pi \end{cases}$.

(b) Estimate $y(0.2)$, given $y' = 3x + \frac{y}{2}$, $y(0) = 1$ using Runge-Kutta 4th order.

[8+8]

6.(a) Find Fourier Sine transform of $\frac{e^{-ax}}{x}$.

(b) Find the Z-transform of $\{x(n)\} = n z^n$

[8+8]

7.(a) Find Fourier transform of $f(x) = \begin{cases} \frac{1}{2a}, & |x| \leq a \\ 0, & |x| > a \end{cases}$.

(b) Solve $u_{n+2} - u_n = 2^n$, $u_0 = 0, u_1 = 1$ using Z-transform.

[8+8]

